

WHAT IS CLAIMED:

1. A device for determining the optimal point of entry of a surgical tool adapted for use by a surgeon in accessing a target site within a patient's body, comprising:
  - 5 (a) an articulated mechanical arm having or accommodating a distal-end pointer;
  - (b) a tracking controller for tracking the position and orientation of the pointer with respect to a predetermined target coordinate;
  - 10 (c) an imaging device in communication with the tracking controller for generating an image of the target site and intervening tissue as seen from a selected point outside of the body, along a line between that point and the target point coordinate; and
  - 15 (d) an actuator, in communication with the tracking controller, for adjusting the position of the mechanical arm so as to orient the axis of the pointer in the direction of the target point coordinate, as the pointer is moved in space to a selected position outside the body;
- 20 wherein the user can approach the target site, or view the target site and intervening tissue, along a trajectory from the selected position to the target point coordinate.
- 25 2. The device of claim 1, wherein the imaging device constructs an image of the target site using previously obtained scan data, and wherein the predetermined target coordinate is assigned using the constructed image.
- 30 3. The device of claim 1, wherein the mechanical arm is a multi-segmented arm.

4. The device of claim 1, wherein, once the optimal point of entry is determined, the pointer can be replaced with a surgical tool to enter the patient's target site along the established trajectory.

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5. A method for maintaining a trajectory toward a target site and for viewing any intervening tissue along the trajectory, as defined by the axis of a viewing instrument and a target coordinate in the target site, while the instrument is moved in space, comprising:

- (a) acquiring scans of the patient;
- (b) using the acquired scans to construct an image of the patient target site;
- (c) assigning the target coordinate on the constructed image;
- (d) correlating an image coordinate system with an instrument coordinate system; and
- (e) controlling the orientation of the instrument to maintain the defined trajectory, as the instrument is moved in space outside the body.

20 6. A processor-readable medium embodying a program of instructions for execution by a processor to perform a method of maintaining a trajectory toward a target site, as defined by the axis of a viewing instrument and a target coordinate in the target site, while the instrument is moved in space, the program of instructions comprising instructions for:

- (a) acquiring scans of the patient;
- (b) using the acquired scans to construct an image of the patient target site;
- (c) assigning the target coordinate on the constructed image;

- (d) correlating an image coordinate system with an instrument coordinate system; and
- (e) controlling the orientation of the instrument to maintain the defined trajectory, as the instrument is moved  
5 in space outside the body.

7. A device for maintaining a trajectory between a tip of an instrument and a moving target in a patient's body, comprising:

10 (a) an articulated mechanical arm having or accommodating a distal-end instrument having a tip that has or accommodates a force contact sensor;

(b) a tracking mechanism for tracking the position and orientation of the instrument with respect to coordinates  
15 of the moving target;

(c) a processor in communication with the tracking mechanism for calculating and updating the coordinates of the moving target; and

(d) an actuator, in communication with the tracking  
20 mechanism, for adjusting the orientation of the mechanical arm, while maintaining a constant pressure between the instrument tip and a surface of the body, so as to maintain the trajectory between the tip of the instrument in the direction of the moving target.

25 8. A method for maintaining a trajectory between a tip of an instrument and a moving target in a patient's body using a robot-held instrument, comprising:

- (a) acquiring scans of the patient;
- (b) using the acquired scans to construct an image of  
30 the patient target site;
- (c) assigning the target coordinate on the constructed image; and

(d) controlling the orientation of the instrument to maintain a trajectory defined by the axis of the probe and a point on the moving target, while maintaining the tip of the instrument at a fixed location against a tissue surface  
5 at a constant pressure, as the instrument is moved in space outside the body.

9. A processor-readable medium embodying a program of instructions for execution by a processor to perform a  
10 method of maintaining a trajectory between a tip of an instrument and a moving target in a patient's body using a robot-held instrument, the program of instructions comprising instructions for:

- (a) acquiring scans of the patient;
- 15 (b) using the acquired scans to construct an image of the patient target site;
- (c) assigning the target coordinate on the constructed image; and
- (d) controlling the orientation of the instrument to  
20 maintain a trajectory defined by the axis of the probe and a point on the moving target, while maintaining the tip of the instrument at a fixed location against a tissue surface at a constant pressure, as the instrument is moved in space outside the body.